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MAR, 1962

891,121 COMPLETE SPECIFICATION

1 SHEET

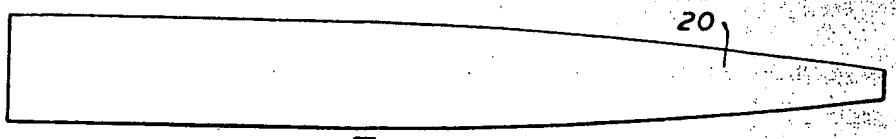

FIG. 1.

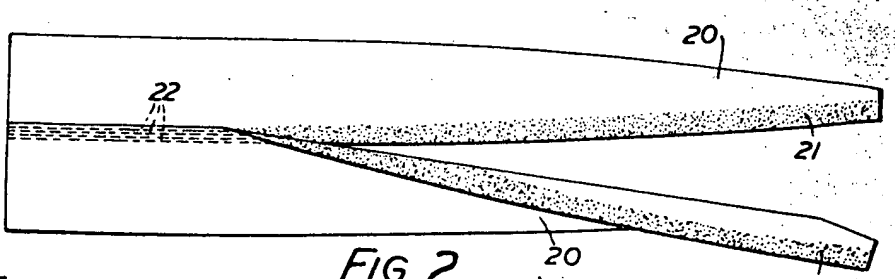

FIG. 2.

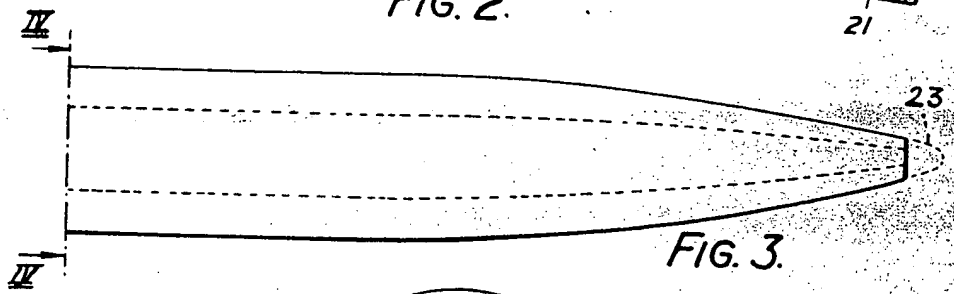

FIG. 3.

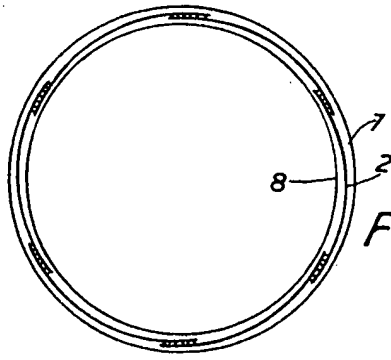

FIG. 4.

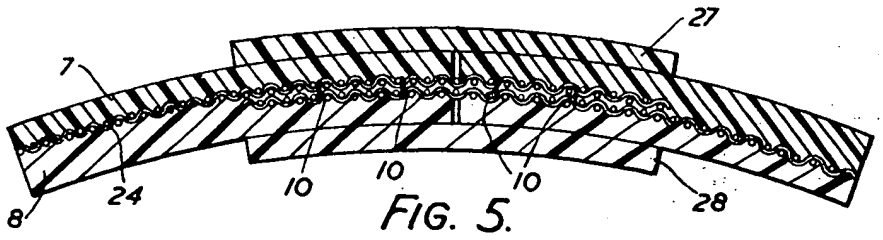

FIG. 5.

891,121 PROVISIONAL SPECIFICATION
1 SHEET

This drawing is a reproduction of the Original on a reduced scale.

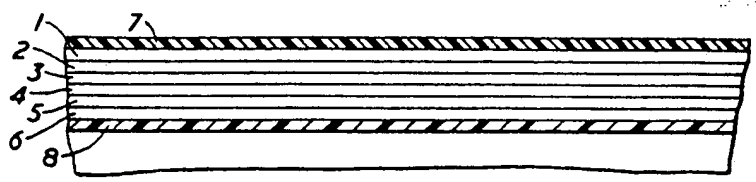

FIG. 1.

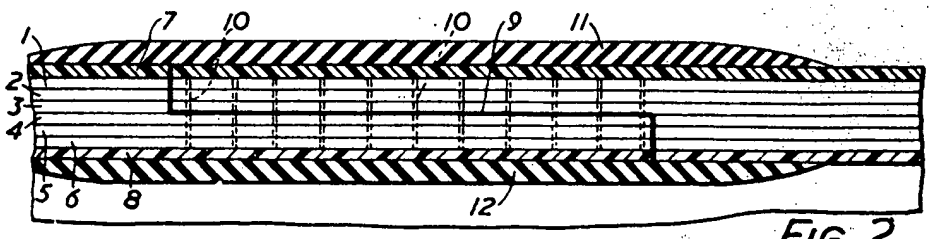

FIG. 2.

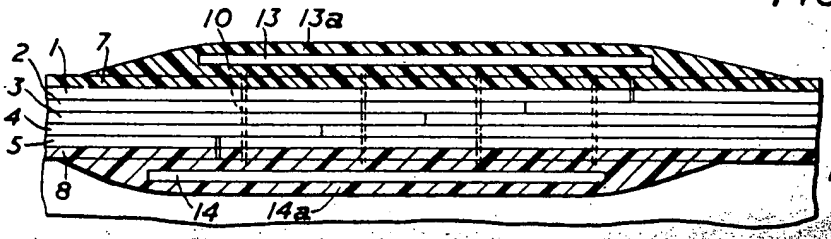

FIG. 3.

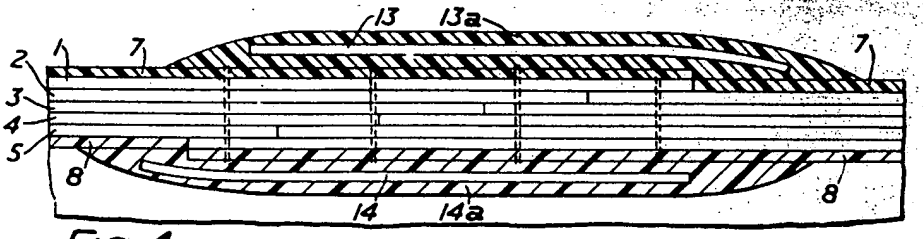

FIG. 4.

FIG. 4a.

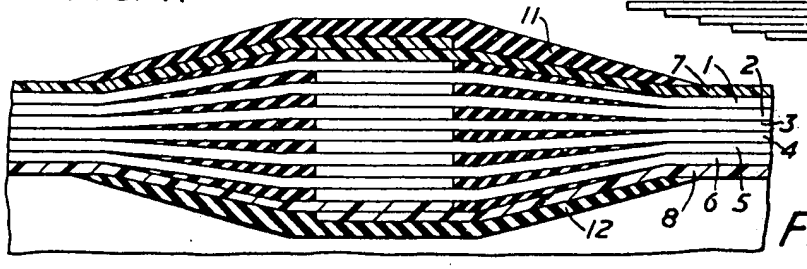

FIG. 5.

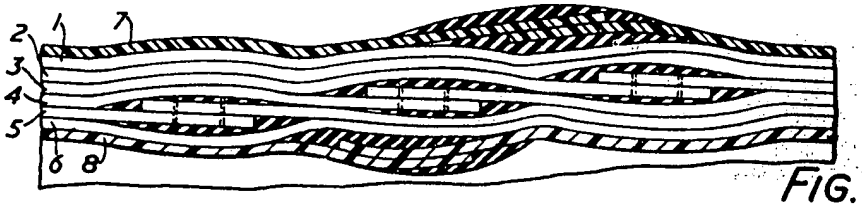

FIG. 6.

PATENT SPECIFICATION

891,121

114

Inventor: WILLIAM REDE HAWTHORNE

Date of filing Complete Specification: May 6, 1958

Application Date: May 7, 1957. *No.* 14509/57

Complete Specification Published: March 14, 1962

Index at Acceptance:—**Classes 113,** A1; **42(1),** K; **and 140,** A2K1(B:C:D:G), A2(N3:N4:P), A5(E:F:G8:G10), A10B(2:3), A11(A:B:C:E2:E3:K1).

International Classification:—B63b. B29d. C09j.

COMPLETE SPECIFICATION

DRAWINGS ATTACHED

Improvements in or relating to Flexible Barges or Storage Vessels

WE, DRACONE DEVELOPMENTS LIMITED, a British Company, of 7 Tilney Street, London, W.1., do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

This invention relates to flexible barges or storage vessels for transporting or storing liquid or solid cargoes in or on inland waters or the sea.

It is desirable that the walls of such barges or storage vessels be such that they can be collapsed or folded. It is desirable, therefore, that the material of such walls be a fabric-like material which can be rolled up, crushed or folded, and which has a good tensile strength, withstands shear and flexing, is impervious to the cargo, is unattacked by water or organisms and withstands weather and sun, abrasion, ripping or puncturing.

According to the invention, a barge or storage vessel of the kind indicated is formed with unsupported walls made up of several load bearing layers of woven or oriented natural or synthetic fibres such as Rayon, Nylon, Terylene (Registered Trade Mark), glass fibres or wire, the composite walls being provided with inner and outer skins of material capable of protecting the load-bearing layers from attack by the intended cargo or by the atmosphere, as the case may be, without necessarily contributing materially to the load-bearing properties of the composite walls.

Tightly woven multi-ply fabrics may be used and may not need extra layers of biased fabric to resist shear. Where orientation is used without weaving, the fibres or filaments or adjacent layers are preferably arranged at an angle to each other. Glass fibre may be used where continued flexing is not likely to occur, for example in storage tanks. Natural fibres may be used where low-strength fabrics are permissible or where extra thickness is required without appreciable additional strength.

The various layers may be made separately, for example, by weaving in one tubular or other shaped piece, and then inserted one inside the other. Internal pressure may be used to hold one layer against the other, or the layers may be held together at appropriately distributed areas or bands by sewing or rivetting or by bonding with glue, plastic or natural or synthetic rubber. Alternatively, the layers may be bonded together throughout.

The inner skin may be of rubber-like material chosen so that it is not attacked by the contents of the barge. The composite walls may be of woven nylon fabric which carries the skin stresses, consisting of lengths of nylon cloth overlapped at the edges and these stuck and sewn together to form one shaped tube. The outer skin may be of rubber-like material similar to the inner layer but chosen so that it resists attack from external agencies such as sea water and sunlight. The protecting skins and load-bearing fabric may be made separately and then bonded together but the two skins may be bonded to the nylon cloth before it is made up into the shape of the barge, and then in their turn stuck together to form the barge or storage vessel.

Where the layers are not bonded together throughout, they may be lubricated by means of a liquid, such as water, or by means of graphite, carbon black or other lubricant, to protect the yarns and remove heat generated during flexing. Where water is used as a lubricant, this may be derived from the outside water by giving this access to the interior of the fabric of the vessel.

[Price 4s. 6d.]

Where the filaments or fibres of one layer are arranged at an angle to those of adjacent layers, oppositely handed helical windings may be disposed one within the other.

Where a woven fabric is employed the relative strengths of the warp and weft are preferably chosen to suit the requirements of the vessel. The material may be arranged so that its greatest strength is developed in the circumferential or hoop direction. This would normally mean that the warp yarns would run circumferentially and the weft yarns longitudinally of the axis of the barge or storage vessel and joints would preferably be circumferential, longitudinal joints being kept to a minimum. However, longitudinally joined strips may be used as hereinafter described.

In a barge of, for example 30′ in diameter and 600′ in length, the ultimate strength of the fabric is preferably not less than 6,000 lb. per inch width of fabric in the circumferential direction and not less than 3,500 lbs. per inch in the longitudinal direction. For different diameters the required strength could be allowed to vary as the square of the diameter.

Each yarn may be covered with a layer of rubber or plastic to bind the cloth and to reduce fretting between the layers, and each layer of cloth may be covered with a binder or with a plastic protective coating. For oil-carrying vessels, natural rubber may be used between the layers so that in the event of leakage some self-sealing action is obtained.

Some seepage of fluid cargo is likely where the fabric is under tension. To reduce such seepage, the inner skin may be made more extensible than the load-bearing layer or layers and it may be fitted slightly oversize. Sufficient extensibility may be obtained by using " two-way stretch " or " crepe " Nylon, rubberised throughout or on one side only.

For some cargoes more than one sealing skin may be used and the skin may be sealed with plastic or rubber. Skins may be separated by fabric in a multi-layer construction.

Impregnating and colouring materials may be used on the outer skin to reduce the effects of biological attack, sunlight and weathering.

For oil-carrying barges, the inner skin may be rubberised with an oil-resistant material such as Hycar (Registered Trade Mark) (a butadiene based artificial rubber) which has been found to adhere satisfactorily to Nylon. The external skin may be of Hycar rubber, neoprene or a plastic such as polyvinyl chloride.

For example, in a preferred embodiment of this invention the stress carrying fabric consists of lengths of multi-layer Nylon cloth, with a strength of 1,000 lbs. per inch width of fabric in both directions. These lengths are shaped and overlapped longitudinally where they are joined by both sticking and sewing. The glue for sticking the overlap is applied immediately below the sewing so that the material and the stiches are all glued together. The nylon cloth is coated on the inside with Hycar rubber bonded to the material and on the outside with neoprene bonded similarly.

Embodiments of the invention will now be described by way of example with reference to the drawings accompanying the Provisional Specification, in which :

Fig. 1 is a fragmentary diagrammatic sectional view of one example of multi-layer fabric for constructing a barge according to the invention, and

Figs. 2-6 show similar views of examples of joints in the fabric.

Reference will also be made to the drawings accompanying the present specification, in which :—

Fig. 1 is a fragmentary view of a portion of said fabric for constructing a barge according to the invention ;

Fig. 2 is a diagrammatic view of two such portions joined together, the joint being shown partially opened ;

Fig. 3 is a fragmentary side sectional elevation of one end of a barge formed from portions of material according to Fig. 1 ;

Fig. 4 is a section on the line IV-IV of Fig. 3 ; and

Fig. 5 is an enlarged view of a joint such as is illustrated in Figs. 2 and 4.

Referring first to Fig. 1 of the drawings accompanying the Provisional Specification, this shows an example of multi-layer fabric for use in constructing a barge according to the invention, said fabric consisting of six layers of nylon cloth 1-6, furnished with an external fabric 7 of neoprene and nylon and an internal sealing fabric 8 of Hycar and nylon.

One of the requirements is that the material should stand up to kinking. To avoid the failure of the proofing under kinking, the proofing should be kept as thin as possible. This makes desirable the use of one or more layers of thinly proofed material.

Fig. 2 shows a lap joint of the material illustrated in Fig. 1, the material being spliced as indicated by the line 9 and sewn as indicated by the broken lines 10, or the material may be stuck instead of, or in addition to. sewing, and the lap joint thus formed sealed with plastic or rubber 11, 12.

Fig. 3 shows a joint in similar fabric, except that only five layers of nylon are shown and instead of splicing the material in Fig. 4a and the outer rubber or plastic seals consist of rubberised or plasticised reinforcing strips 13, 14 respectively of which the rubberizing or plasticising is shown at 13a and 14a respectively. The whole may then

be reinforced by sewing. Fig. 4 shows a modified joint in which the outer layers 7 and 8 are also staggered. All these joints can be adapted to either multi-layer or multi-ply fabric and when rubber is used would be vulcanised or aged after joining. Alternatively, the rubber may be applied in layers, with each layer adhesively secured together by a tacky material.

Fig. 5 shows a multi-layer fabric in which each layer is separately joined in a lap joint.

In Fig. 6, the lap joints of a multi-layer fabric are staggered.

Turning now to the drawings accompanying the present specification, Fig. 1 shows the end of a length of multi-layer woven nylon 20 which is shaped as shown and stuck together by an adhesive indicated at 21 in Fig. 2, the joints being then sewn as indicated at 22 to make up a vessel whose shape is cylindrical with streamlined ends as illustrated in Fig. 3, a suitable end fairing 23 being provided. A cross-section of the vessel is illustrated diagrammatically in Fig. 4 which shows how the seams are overlapped, the nylon fabric being indicated at 24, the Hycar proofing at 8 and the neoprene proofing at 7.

A view of one of the joints is shown on an enlarged scale in Fig. 5 from which it will be seen that the seams are sewn as indicated at 10 and the rubberlike internal and external layers are bonded by reinforcement strips 27, 28 of neoprene and Hycar respectively.

If the strength-bearing fabric is woven in one piece, it may be reinforced locally to strengthen imperfections due to the weaving process. Local strengthening may be achieved by proofing the fabric with plastic or rubber and sticking extra layers of fabric to the low strength region. Similar local strengthening may be achieved by sewing or rivetting a strengthening patch to the main fabric and proofing afterwards. Alternatively, if separate inner and/or outer sealing skins are used, proofing after sewing or rivetting may not be necessary. Strengthening of the fabric may be done locally at places where the stresses are high, for example at points of attachment of a towing bridle and over areas of shaped ends where stresses due to buoyancy or the pressure in the flow past the vessel are high.

WHAT WE CLAIM IS:—

1. A barge or storage vessel of the kind indicated, formed with unsupported walls made up of several load-bearing layers of woven or oriented natural or synthetic fibres or wire, the composite walls being provided with inner and outer skins of material capable of protecting the load-bearing layers from attack by the intended cargo or by the atmosphere, as the case may be.

2. A vessel according to Claim 1, wherein the various layers are made separately and are then inserted one within the other.

3. A vessel according to Claim 2, wherein the layers are each formed by weaving in one tubular or other shaped piece.

4. A vessel according to Claim 2 or Claim 3, wherein internal pressure is used to hold one layer against the other.

5. A vessel according to Claim 2 or Claim 3, wherein the layers are held together at distributed areas or bands by sewing or rivetting or by bonding with glue, plastic or natural or synthetic rubber.

6. A vessel according to Claim 2 or Claim 3, wherein the layers are bonded together throughout.

7. A vessel according to Claim 4, wherein the layers are lubricated by means of a liquid such as water or by means of graphite, carbon or other lubricant.

8. A vessel according to Claim 7, wherein water is used as the lubricant and is derived from the outside water by giving this acess to the interior of the fabric of the vessel.

9. A barge for containing oil, as claimed in any preceding claim, wherein the inner skin is rubberised with an oil-resistant material such as butadiene based artificial rubber.

10. A barge for containing oil, substantially as hereinbefore described with reference to any one or more of the Figures of the drawings accompanying the Provisional Specification and/or the Complete Specification.

For the Applicants,
D. YOUNG & CO.,
Chartered Patent Agents,
9 Staple Inn, London, W.C.1.

PROVISIONAL SPECIFICATION

Improvements in or relating to Flexible Barges or Storage Vessels

WE, DRACONE DEVELOPMENTS LIMITED, a British Company, of 7 Tilney Street, London, W.1., do hereby declare this invention to be described in the following statement:—

This invention relates to flexible barges or storage vessels for transporting or storing liquid or solid cargoes.

It is desirable that the walls of such barges or storage vessels be such that they can be collapsed or folded. It is desirable, therefore, that the material of such walls be a fabric-like material which can be rolled up, crushed or folded, and which has a good tensile strength, withstands shear and flexing, is impervious to the cargo, is unattacked by water or organisms and withstands weather and sun, abrasion, ripping or puncturing.

According to the invention, a barge or storage vessel is formed with unsupported walls of natural or synthetic fibres such as Rayon, Nylon, Terylene, glass fibres or wire, woven or oriented and bonded together with a plastic material or natural or synthetic rubber.

Multi-ply fabric or several layers of fabric may be used. Preferably, several load-bearing layers of fibrous material are bonded together and provided with inner and/or outer skins of material intended primarily to protect the load-bearing layers from attack by the cargo or by the atmosphere, as the case may be, without necessarily contributing materially to the load-bearing properties of the composite fabric.

The fibres may be loosely woven or may be in the form of a wire cloth or simply oriented. Where orientation is used without weaving, the fibres or filaments of adjacent layers are preferably arranged at an angle to each other. Glass fibre may be used where continued flexing is not likely to occur, for example in storage tanks. Natural fibres may be used where low-strength fabrics are permissible or where extra thickness is required without appreciable additional strength.

The various layers may be made separately, for example by weaving in one tubular or other shaped piece, and then inserted one inside the other. Internal pressure may be used to hold one layer against the other, or the layers may be held together at appropriately distributed areas or bands by sewing or rivetting or by bonding with glue, plastic or rubber. Alternatively, the layers may be bonded together throughout.

Where the layers are not bonded together throughout, they may be lubricated by means of a liquid, such as water, or by means of graphite, carbon black or other lubricant, to protect the yarns and remove heat generated during flexing. Where water is used as a lubricant, this may be derived from the outside water by giving this access to the interior of the fabric of the vessel.

Where the filaments or fibres of one layer are arranged at an angle to those of adjacent layers, oppositely handed helical windings may be disposed within the other.

Where a woven fabric is employed the relative strengths of the warp and weft are preferably chosen to suit the requirements of the vessel. The material will normally be arranged so that its greatest strength is developed in the circumferential or hoop direction. This would normally mean that the warp yarns would run circumferentially and the weft yarns longitudinally of the axis of the barge or storage vessel. Joints are preferably circumferential, longitudinal joints being kept to a minimum.

In a barge of, for example, 30′ in diameter and 600′ in length, the ultimate strength of the fabric is preferably not less than 6,000 lb. per inch width of fabric in the circumferential direction and not less than 3,500 lb. per inch in the longitudinal direction. For different diameters the required strength could be allowed to vary as the square of the diameter.

Each yarn may be covered lightly with a layer of rubber or plastic to bind the cloth and to reduce fretting between the layers, and each layer of cloth may be covered with a binder or with a plastic protective coating. For oil-carrying vessels, natural rubber may be used between the layers so that in the event of leakage some self-sealing action is obtained.

Some seepage of fluid cargo is likely where the fabric is under tension. To reduce such seepage, the inner skin may be made more extensible than the load-bearing layer or layers and it may be fitted slightly oversize. Sufficient extensibility may be obtained by using "two-way stretch" or "crepe" Nylon, rubberised throughout or on one side only.

For some cargoes more than one sealing skin may be used and the skin may be sealed with plastic or rubber. Skins may be separated by fabric in a multi-layer construction.

Some materials suitable for the load-bearing layers, for example, Terylene, do not necessarily lose strength in sun and weather. Nylon may be treated to prevent loss of strength and in such a case an external protective rubber or plastic skin may not be necessary. Where an outer skin is used, impregnating and colouring materials may be used to reduce the effects of biological attack, sunlight and weathering.

For oil-carrying barges, the inner skin may be rubberised with an oil-resistant material such as Hycar (a butadiene based artificial rubber) which has been found to adhere satisfactorily to Nylon. The external skin may be of Hycar rubber, neoprene or a plastic such as polyvinyl chloride.

In the accompanying drawings:—

Fig. 1 shows an example of multi-layer fabric according to the invention, six layers of Nylon cloth being furnished with an external fabric of neoprene and Nylon and an internal sealing fabric of Hycar and Nylon.

One of the requirements is that the material should resist kinking. To avoid the failure of the proofing under kinking, the proofing should be kept as thin as possible. This makes desirable the use of one or more layers of thinly-proofed material.

Figs. 2-6 show examples of joints in the fabric.

Fig. 2 shows a lap joint plasticized or rubberized and sewn.

In Fig. 3, the external rubberizing material carries one or more strips of strong material

to reinforce the joint. A similar construction is shown in Fig. 4 which illustrates a chamfered lap joint with external reinforcement and rubberising. All these joints can be adapted to either multi-layer or multi-ply fabric, and when rubber is used would be vulcanized or aged after joining. Alternatively, the rubber may be applied in layers, with each layer adhesively secured together by a tacky material.

Fig. 5 shows a multi-layer fabric in which each layer is separately joined in a lap joint. The fabric is rubberised and lap-jointed by pressure followed by vulcanisation or is adhesively secured with a rubber adhesive.

In Fig. 6 the lap joints of a multi-layer fabric are staggered.

Tightly woven multi-ply fabrics may be used and may not need extra layers of biased fabric to resist shear.

If the strength-bearing fabric is woven in one piece, it may be reinforced locally to strengthen imperfections due to the weaving process. Local strengthening may be achieved by proofing the fabric with plastic or rubber and sticking extra layers of fabric to the low strength region. Similar local strengthening may be achieved by sewing or rivetting a strengthening patch to the main fabric and proofing afterwards. Alternatively, if separate inner and/or outer sealing skins are used, proofing after sewing or rivetting may not be necessary. Strengthening of the fabric may be done locally at places where the stresses are high, for example at points of attachment of a towing bridle and over areas of shaped ends where stresses due to buoyancy or the pressure in the flow past the vessel are high.

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Agents for the Applicants.

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